

## SMALL-SIZED OPENING AND CLOSING DEVICE

### BACKGROUND OF THE INVENTION

#### 5 1. FIELD OF THE INVENTION

The present invention relates to a small-sized opening and closing device well fitted especially to a foldable small-sized electronics device such as a portable telephone or a personal digital assistant, and so force.

#### 10 2. DESCRIPTION OF THE RELATED ART

Among small-sized electronics devices, as is a portable telephone, for example, there is a foldable type in which a transmitter section as a first member and a receiver section as a second member are constructed separately, and then relatively connected to open and close by means of a small-sized opening and closing device to which both members are attached to the connecting portion. Such a small-sized opening and closing device is publicly known as shown in Japanese Patent Laid-open No. 2000-337008.

The small-sized opening and closing device described in the above document has a structure that has a shaft which has an arresting portion on one end, a case body with a baffle, to which the shaft is inserted in the central axial direction and is arrested to the mentioned arresting portion, a slider cam which has a cam portion, which is slidably arrested in an axial direction to a key groove which is provided at an open end side of the mentioned case body, and is composed of a pair of a convex portion and a concave portion which is provided at a 180 degrees symmetric position on one end phase, and to which the mentioned shaft is inserted in the central axial direction, a cam member which has a cam portion composed of a pair of a concave portion and a convex portion which is provided at a 180 degrees symmetric position on an end section facing to the cam portion of the slider cam, and to which the mentioned shaft is inserted in the central axial direction, and a compression spring which is wound around the mentioned shaft, stored in the mentioned case body, and is interposed resiliently between this case body and the mentioned slider cam.

## SUMMARY OF THE INVENTION

A portable telephone which is publicly known in the prior art, has an advantage that there is no tilt or twist because a shape of each cam portion is 5 180 degrees symmetry, and has a structure that a transmitter section and a receiver section can be opened from the closed position of which the closing angle is 0 (zero) degree to the full open position of which the opening angle is 160 degrees. Furthermore, the small-sized opening and closing device which is publicly known in the prior art has a structure that, the receiver section 10 closes automatically relative to the transmitter section by the resilient force of the compression spring from the closing angle of 20 degrees to 0 (zero) degree, but actually it tries to close up to minus 10 degrees, so it is locked in the stopped state and is not clapped out. When the receiver section opens relative to the transmitter section, it has a structure that opens automatically from the 15 opening angle of 140 degrees to the full open position of 160 degrees, but actually it tries to open up to 170 degrees, so it is locked at the full open state of 160 degrees, and is not clapped out. That is, from minus 10 degrees to 170 degrees, the totaled angle becomes 180 degrees. This means that by changing the shape and the position of the convex portion and the concave portion of 20 each cam, a convex portion of one cam portion is in the status that does not completely fall in to a concave portion of the other cam portion.

Therefore, the small-sized opening and closing device which is publicly known in the prior art has problems that it is hard to have a structure to open more than 160 degrees, with an automatic closing and automatic opening 25 function, hence has a limit in the automatic opening and closing angle or its movement, and it is hard to change the specification.

The object of the present invention is to provide a small-sized opening and closing device especially for a portable telephone, which has a different specification from the former one in the automatic opening and closing angle 30 of the receiver section relative to the transmitter section and its movement, and the opening angle is not limited to 160 degrees.

The following explanation is for the case when the present invention is

applied to a foldable portable telephone, but it goes without saying that the hinge device concerning to the present invention can be applied to small-sized personal digital assistants or other electronics devices than the foldable portable telephone.

5 To accomplish the above mentioned objects, the present invention connect a first member and a second member which construct a small-sized electronics device with each other to open and close, and composed of a shaft, a cam member attached to the shaft, having a 180 degrees symmetric cam portion composed of a convex portion and a concave portion on one end phase thereof, and arrested its rotation by one connecting portion of either the first member or the second member, a slider cam attached slidably to the shaft facing to the cam member, having a 180 degrees symmetric cam portion composed of a convex portion and a concave portion on a side thereof facing the cam portion of the cam member, and arrested its rotation by the other 10 connecting portion of either the first member or the second member, and a compression spring wound around the shaft to push the slider cam toward the cam member side, and wherein each cam portion provided on an opposed side 15 of the cam member and the slider cam separate by the position of axial core side or the outside to provide each 180 degrees symmetric cam at a different 20 position, at least a pair of 180 degrees symmetric cams on axial core side and the outside.

In the present invention, the slider cam is provided slidably in a cam case with a baffle on the outside, while arresting its rotation.

Also in the present invention, in order that the cam member or the cam 25 case is to be fixed on the shaft, an arresting groove in a radial direction on a fixed portion of the shaft is provided to arrest the arresting groove with the cam member or the cam case by using a fixed pin inserted from a radial direction.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

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FIG. 1 is a plane view of an opened portable telephone using a small-sized opening and closing device according to the present invention;

FIG. 2 is a front view showing an attached status of a transmitter section and a receiver section to each connecting portion of the small-sized opening and closing device according to the present invention;

5 FIG. 3 is a schematic cross sectional view of the small-sized opening and closing device shown in FIG. 2;

FIG. 4 is an explanatory view describing the movement of the small-sized opening closing device when the receiver section is opened relative to the transmitter section;

10 FIG. 5 is an explanatory view describing the position of a cam member and each cam portion of a slider cam when the receiver section is closed relative to the transmitter section;

FIG. 6 is an explanatory view describing the position of the cam member and each cam portion of the slider cam when the receiver section is 170 degrees opened relative to the transmitter section;

15 FIG. 7 is a left side view of a case body;

FIG. 8 is a right side view of the cam member;

FIG. 9 is a plane view of the cam member;

FIG. 10 is a left side view of the cam member;

FIG. 11 is a sectional front view of the cam member;

20 FIG. 12 is a left side view of the slider cam;

FIG. 13 is a bottom view of the slider cam;

FIG. 14 is a right side view of the slider cam;

FIG. 15 is a sectional front view of the slider cam;

FIG. 16 is a left side view of an arresting member;

25 FIG. 17 is a partial disassemble elevation view showing another embodiment of the small-sized opening and closing device according to the present invention;

30 FIG. 18 is a partial disassemble elevation view showing still another embodiment of the small-sized opening and closing device according to the present invention;

FIG. 19 is a partial disassemble elevation view showing yet another embodiment of the small-sized opening and closing device according to the

present invention; and

FIG. 20 is a partial disassemble elevation view showing further another embodiment of the small-sized opening and closing device according to the present invention.

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## **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)**

An embodiment of the present invention will be described below in detail by referring to drawings. A reference number 1 denotes a foldable portable telephone in FIG. 1. A reference number 2 denotes a transmitter section which constructs a first member thereof, and includes a keyboard portion 2a and a microphone portion 2b. A reference number 3 denotes a receiver section which constructs a second member thereof, and includes a display unit 3a composed of, for example, a liquid crystal display unit and a speaker portion 3b.

A small-sized opening and closing device A according to the present invention, relatively connects the transmitter section 2 as the first member, and the receiver section 3 as the second member, with each other to open and close, and the device A is loaded between a connecting portion 2c, 2c of the transmitter section 2, and a connecting portion 3c, 3c of the receiver section 3.

In the drawings, the small-sized opening and closing device A is used, but a pair of devices A can be used. The structure of the small-sized opening and closing device A will be described below.

FIG. 2 to 16 show the small-sized opening and closing device A and parts according to the present invention, and as especially shown in FIG. 3 and FIG. 4, a reference number 5 denotes a shaft, which is made of SUM24L, and is carburized and quenched. The shaft 5 has a flange portion 5a on one end portion, followed by a medium-diameter portion 5b, and a small-diameter portion 5c, and on one side of a free end side of the small-diameter portion 5c, there is provided a half-round engaging groove 5d across in an axial direction.

A reference number 6 denotes a case body. As especially shown in FIG. 2 to FIG. 5, the case body 6 has an anti-rotation means 6a, 6a which is

composed of a pair of races on an outer periphery along the axial direction, and one end thereof is open, in which an axial bearing hole 6c provided on a side wall 6b receives therein the small-diameter portion 5c of the shaft 5, and an arresting groove 5d engages with a fixed pin 7 with being arrested to the 5 case body 6 so as not to come off in an axial direction. Of course, the arresting groove 5d may be an arresting hole in a case that the diameter of the shaft 5 is large. On the small-diameter portion 5c of the shaft 5, a cam member 8 is attached, while the small-diameter portion 5c engageably passes through a through hole 8a. And, to the flange portion 5a and the 10 medium-diameter portion 5b of the shaft 5, an arresting member 9 which has four arresting claws 9a is engaged, by arrestedly passing through an arresting hole 9b. On an outside of the cam member 8, the anti-rotation means 8b, 8b which is composed of a race, 8b is provided.

At the other open end portion of the case body 6, a slider cam 12 is 15 allocated, while the small-diameter portion 5c of the shaft 5 slidably passes through a through hole 12a, which is provided in the central axial direction thereof. Between the slider cam 12 and the side wall 6b of the case body 6, a compression spring 13 is interposed resiliently, while it is spirally wound around the small-diameter 5c, and the slider cam 12 is constantly pushed 20 toward the cam member 8 side.

On the outside of the slider cam 12, a key portion 12b, 12b is provided to engage with a key groove 6d, 6d which is provided on the case body 6 and there is also provided a cam portion 10 at a surface confronting to the cam member 8. The cam portion 10 is composed of an inner cam convex portion 25 10a, which consists of a convex portion provided at an axial core side, and an outer cam convex portion 10b, which consists of a convex portion provided at 180 degrees point from the inner cam convex portion 10a. In FIG. 12, the shaded area denotes a common concave portion 10c. A cam portion 11 of the cam member 8 is provided with facing to the cam portion 10 of the slider cam 30 12, and the cam portion 11 is composed of an inner cam 11c, which locates inside of the axial core side and consists of a convex portion 11a, 11a and a concave portion 11b, 11b, and an outer cam 11f, which locates at 10 degrees

outside point and consists of a convex portion 11d, 11d and a concave portion 11e. On sliding portion of each cam portion, 10 and 11, some viscosity lube oil such as silicone oil are applied, though it is not shown in the drawings.

And, as especially shown in FIG. 1 to FIG. 5, the small-sized opening and closing device A is inserted into a deformed mounting hole 2d which is provided at the connecting portion 2c of the transmitter section 2 from the arresting member 9 side, the cam member 8 side is inserted to a deformed mounting hole 3d which is provided at the connecting portion 3c of the receiver section 3 to thereby engage them through each anti-rotation means 8b, 10 8b, the case body 6 side is inserted to the deformed mounting hole 2d which is provided at the connecting portion 2c of the transmitter section 2 so as to engage them through the anti-rotation means 6a, 6a, and then the arresting claw 9a, 9a of the arresting member 9, engage with edge portion of the connecting portion 3c, then the assembling of the small-sized opening and 15 closing device A into the portable telephone 1 is completed.

Therefore, in a 0 (zero) degree state where the receiver section 3 as the second member is closed relative to the transmitter section 2 as the first member, as denoted by a reference line "a" in FIG. 5, the outer cam convex portion 10b of the cam portion 10 of the slider cam 12 is completely fall in the 20 concave portion 11e of the outer cam 11f of the cam portion 11 of the cam member 8, but as denoted by a reference line "b", the inner cam convex portion 10a of the cam portion 10 of the slider cam 12 is partially fall in the concave portion 11b of the inner cam 11c of the cam portion 11 of the cam member 8. This means that there is a gap of 10 degrees. Therefore, the receiver section 3 25 is locked in the stopped state relative to the transmitter section 2, because it tries to close for more 10 degrees.

From this status, the receiver section 3 as the second member opens relative to the transmitter section 2 as the first member, then the cam member 8 is opened by rotating with the connecting portion 3c of the receiver section 3. 30 When it opened up to 150 degrees, the convex portion 11d of the outer cam 11f of the cam portion 11 of the cam member 8 falls in the common concave portion 10c side of the cam portion 10 of the slider cam 12, and the receiver

section 3 will be opened automatically by the resilient force of the compression spring 13, and will be stopped at the opening angle of 170 degrees, by the stopper which is not shown in the drawings. At this time, the inner cam convex portion 10a of the cam portion 10 of the slider cam 12, as denoted by a 5 reference line "c" in FIG. 6, completely falls in the concave portion 11b of the inner cam 11c of the cam member 8, and the convex portion 11d of the outer cam 11f of the cam portion 11, as denoted by a reference line "d" in FIG. 6, does not completely fall in the common concave portion 10c of the cam portion 10, so it tries to open up to 180 degrees which is 10 degrees over, then 10 the receiver section 3 is locked at the opening angle of 170 degrees relative to the transmitter section 2, and is not clapped out.

When the opened receiver section 3 is being closed relative to the transmitter section 2, the convex portion 11a of the inner cam 11c of the cam portion 11 of the cam member 8 and the convex portion 11d of the outer cam 15 11f fall in the common concave portion 10c of the cam portion 10 of the slider cam from the closing angle of 20 degrees, then it closes automatically by the resilient force of the compression spring 13, and at the closing angle of 0 (zero) degree, the convex portion 11d of the outer cam 11 of the cam portion 11 of the cam member 8 is on the point that completely fall in the common concave portion 10c of the slider cam 12, but the convex portion 11a of the inner cam 11c of the cam portion 11 of the cam member 8 is in the middle of the common concave portion 10c of the cam portion 10 of the slider cam 12, and it has room to close until minas 10 degrees, so the receiver section 3 is locked in a closed 20 state relative to the transmitter portion 2, and is not clapped out.

25 In addition, when the opening angle of the receiver section 3 relative to the transmitter section 2 is from 20 degrees to 150 degrees, the inner cam convex portion 10a of each cam portion 10, the outer cam convex portion 10b, the inner cam 11c of the cam portion 11, each convex portion 11a of the outer cam 11f, and 11d are crimping and sliding, and it can be stopped in a free 30 stopping way.

In another embodiment, the cam portion 11 which is provided on the cam member 8 side and the cam portion 10 which is provided on the slider cam

12 side can be reversed, or the convex portions which are to be provided at 180 degrees symmetric position of both inner and outer sides one by one, can be provided at 180 degrees symmetric position pair by pair. The cam member 8 can be fixed on the connecting portion 2c of the transmitter section 2, and the 5 case body 6 can be fixed on the connecting portion 3c of the receiver section 3. The case body 6 can be omitted and instead the slider cam 12 is to be slidably engaged with the shaft 5 in the axial direction while arresting its rotation. Furthermore, by changing each shape and the setting position of the inner cam portion and the outer cam portion of the cam portion 10, and the inner cam and 10 the outer cam of the cam portion 11, the first member and the second member can be opened more than the angle of 180 degrees, while the advantage is held even if a 180 degrees symmetric cam is used.

FIG. 17 shows another embodiment of a small-sized opening and closing device B of the present invention, and differs from the first 15 embodiment of the small-sized opening and closing device in the point that an arresting hole 20b is provided on a free end side of a small-diameter portion 20a of a shaft 20, but others are the same. In the arresting hole 20b, a fixed pin 21 is inserted and engages the shaft 20 with a case body 22. When a diameter of a shaft is large enough to have an arresting hole to insert an 20 arresting pin, these embodiment can be implemented.

FIG. 18 shows still another embodiment of a small-sized opening and closing device of the present invention, and this small-sized opening and closing device C omits arresting members, and engages an arresting hole 25c which is provided on a small-diameter portion 25a of a shaft 25 with a cam 25 member 26 through a fixed pin 27, and a case body 28 is arrested by a flange portion 25b of a shaft 25, and these are the different points from the former embodiments. The other structure is the same as the former embodiments. The object of the present invention can be accomplished by this embodiments.

FIG. 19 shows yet another embodiment of a small-sized opening and closing device of the present invention, and in this small-sized opening and closing device D, a free end side of a small-diameter portion 30a of a shaft 30 is arrested to a case body 32 with a snap ring 31 composed of, for example, an

E ring, and that is the different point from the former embodiments. The other structure is the same as the former embodiments. The object of the present invention can be accomplished by this embodiment.

FIG. 20 shows further another embodiment of a small-sized opening and closing device of the present invention, and in this small-sized opening and closing device E, a small-diameter portion 35b of a shaft 35 is arrested to a cam portion 36 with a snap ring 37 composed of, for example, an E ring, and a case body 38 is arrested with a flange portion 35 of a shaft 35, and these are the different points from the former embodiments, and the other structure is the same. The object of the present invention can be accomplished by this embodiment.